# PATENT SPECIFICATION 800,864

*Inventor*:—HENRY EDWARD COLLINS.

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International Classification :—E21c.


COMPLETE SPECIFICATION.

## Improvements in or relating to Mining Machines.

We, COAL INDUSTRY (PATENTS) LIMITED, a Company organised in accordance with the laws of Great Britain, of Hobart House, Grosvenor Place, London, S.W.1, England, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to mining machines for the mechanical winning and loading of mineral in mines, especially of coal in underground coal mines.

In the conventional mining of coal by the "stall system", the coal between two series of parallel roadways (generally at right angles the one to the other) is extracted from narrow headings or stalls. After breaking down the coal, usually by means of pneumatic picks or explosives, the broken coal is loaded into tubs or on to a conveyor. The roof in the stall is usually supported on props and bars either of wood or steel.

An object of the present invention is to provide an improved machine whereby it is possible to win and load the coal simultaneously, without the necessity of men having to enter the stall from which the coal is being extracted, and also with the complete absence of roof supports in the stall.

According to the invention there is provided a mining machine comprising a propulsion unit or carriage which travels along a mine gate or roadway and is connected to a cutting head adapted to cut into a seam of mineral and is provided with means for forcing the cutting head into the seam and withdrawing the cutting head from the seam, characterised in that the cutting head is of the closed-loop type and is connected to the propulsion unit or carriage by two or more horizontal or substantially horizontal pushing rods which are parallel to each other and can be extended laterally from the propulsion unit or carriage substantially perpendicularly to the direction of motion of the propulsion unit or carriage and move the cutting head in the direction in which they extend. The parallel pushing rods may be hollow and of any suitable cross-section and built up of sections secured together by locking devices to which are attached bracing members such as cross-tubes whereby the pushing rods are interconnected. Any suitable means may be provided for progressing cut mineral away from the cutting head; in one advantageous construction such means is in the form of one or more conveyors, and rollers for supporting a belt forming part of a conveyor may be mounted on bracing members such as cross-tubes interconnecting the pushing rods. The means on the propulsion unit for forcing the cutting head into the seam and/or withdrawing may comprise one or more hydraulic cylinders. The hydraulic cylinder or cylinders may act through pawls which engage extension pieces secured to the pushing rods. The pawls may be provided with means, for example balance weights, which cause the pawls to revert automatically to their operative positions after being deflected. The propulsion unit is situated in the preformed gate or roadway and the operators, two in number, can control the complete working of the machine from this gate or roadway.

When the cutting head is fully retracted from the seam position into the preformed gate or roadway, the cutting head lies over the top of the propulsion unit. This arrangement is compact and allows direct entry of the cutting head into the coal at the commencement of each stall. In an advantageous construction the cutting head comprises two pilot drills and cutter picks attached to two tee or mushroom-shaped housings to cut

clearances for two sprockets driving a main cutting chain. The latter may cut round an area of a height equal to the height of the seam and of a predetermined length of six feet or more. Power for the cutting elements and conveyor may be provided by a compressed air turbine or electric motor and may be transmitted through reduction gearing and a flexible coupling. A compressed air hose or electric cable may be stowed on a reel or reels mounted on the propulsion unit and be paid out as the cutter head advances in the seam. A water hose may be similarly carried to supply sprays for dust suppression at the face of the stall. So that any fillet of mineral left within the area cut around by the cutting head may be broken down, a cutter chain guide or chute entrance may be fitted with breaker knives. The broken coal or mineral and cuttings from the various cutting members may be constrained by guide plates or a chute to move on to progressing means such as a conveyor, preferably a chain conveyor. Preferably there is also a belt conveyor arranged to be pulled forward in the stall by the cutting head as the latter is pushed forward by the propulsion unit; at the junction of the stall and the roadway the conveyor belt may take a right-angled or other turn into the roadway and pass to an appropriate loading jib by which the mineral or coal is delivered into tubs or mine cars. Sufficient spare belting for the conveyor may be stored in a loop-take-up to allow of the forward movement of the head of the conveyor along the stall. with the cutting head. A right-angled or other turn in the belt can be achieved by appropriately designed and placed rollers or guides. Means, for example roof guides, may be provided for preventing up-and-down movement or "whip" of the pushing rods. Further features of the invention appear from the following description and claims.

In the accompanying drawings the invention is illustrated by way of example:—

Figure 1 being a simplified diagram of the general arrangement of a machine according to the invention as seen in side view;

Figure 2 a side elevation of a machine according to the invention;

Figure 3 a plan corresponding to Figure 2;

Figure 4 a section on the line A—A of Figure 2;

Figure 5 a sectional detail view of a pushing rod joint;

Figure 6 a view in the direction of arrow B of Figure 5;

Figure 7 a side view of a roof guide;

Figure 8 an end view of the roof guide of Figure 7; and

Figure 9 a diagrammatic view of the cutting line of the cutting head.

The illustrated machine comprises a cutting head which carries two pilot drills 1; two sprocket clearance cutters 2 having mushroom-shaped housings fitted with cutter picks; a cutter chain 3 fitted with cutter boxes 4, scrapers 35, and cutter picks 5 driven by the driving sprocket 6 with a return tension sprocket 7. These cutting elements cut the coal in a forward direction, the chain cutting around an elongated oval area whilst the pilot drills 1 and sprocket clearance cutters 2 remove the coal to allow the forward movement of the driving and tension sprockets 6 and 7.

Drive for the cutting elements 1, 2, 3 is derived from a compressed-air turbine (or electric motor) 8 through reduction gearing 9 and flexible coupling 10.

The cutting elements 1, 2, 3 leave a solid fillet of coal within the area cut around by the cutting elements and this coal is broken down by contact with breaker knives 11. The cuttings and broken coal are diverted on to an endless chain scraper conveyor 12 by means of a chute 13. The endless chain scraper conveyor 12 discharges on to a conveyor belt 34. The cutting elements 1, 2, 3 driving unit 8 and gearing 9, a return roller 14 for the conveyor belt 34 and four spring-loaded guide blocks 15 are mounted on a base plate 16. Exhaust air ducting 47 (Figs. 1 and 3) is provided to direct the exhaust air from the turbine 8.

The propulsion unit, which is situated in the roadway from which the stalls are to be driven in the coal seam, comprises a steel girder construction framework 17 mounted on wheels 18 which run on steel rails 19 for ease of movement to successive stall positions along the roadway. Within this framework 17 is mounted a horizontal hydraulic pushing cylinder 20 attached to a plate 21 provided with slides 22 moving on heavy tubular guides 23. The cylinder moves on a self-aligning piston rod 46 (Fig. 1) secured to the framework 17. Motive power for the horizontal pushing cylinder 20 is supplied by an all-enclosed motor-driven hydraulic unit 24 mounted on the girder framework 17.

Attached to the plate 21 of the pushing cylinder 20 are two pushing pawls 25 for forward movement and two similar pawls 26 for backward movement of an assembly of pushing rods 27. When the cutting head is being advanced along the stall, the backward movement pawls 26 are locked out of position. The forward movement pawls 25 automatically engage concave extension pieces 28 (Fig. 5) secured to the pushing rods 27. After the pushing cylinder 20 has moved its full stroke it is retracted, and on the reverse movement the forward movement pawls 25 are deflected into a horizontal position by the passage of succeeding pieces 28 at the joints in the pushing rods 27, but the pawls 25 revert to their vertical operative

positions by the action of balance weights 29. The pawls 25 can then automatically engage with further concave extension pieces 28 as the forward and reverse strokes of the pushing cylinder 20 are repeated.

When withdrawing the cutting head from the stall the forward moving pawls 25 are locked out of position, and the backward moving pawls 26 are freed for operation, and the pawls 26 have an operation which is of a similar nature to that of the pawls 25 but in the reverse direction.

This arrangement enables the cutting head to be retracted over the propulsion unit for moving over the machine to the next cut.

The pushing rods 27 are made in suitable lengths for ease of attachment and detachment. Each section is connected rigidly to its neighbour by a locking key 31. For each joint a connector 32 has one end welded inside one end of one pushing rod section; the other end receives a tapered plug secured to the end of the next pushing rod section. This connector 32 (Fig. 5) is positioned and locked by a plate 33 which is dropped into recesses cut in the connector 32 and similarly dimensioned recesses cut in the pushing rod section 27. The joint is further locked by engaging the locking key 31 of a spring-loaded roof guide 36 (Figs. 2, 7, 8) in holes drilled through the outer part of one rod 27 and an inner tapered plug connector 30 secured in the adjoining rod 27.

The joint interlock plates 33 form parts of spacer units which also comprise two cross-tubes 37 each and brace together the parallel pushing rods 27. Each spacer unit also carries trough idlers 38 for supporting a conveyor belt 34. Roller roof guides 36 are guided into the seam by guide frame 45 and are provided to prevent "whip" on the pushing rods 27 as the cutting head is pushed forward into the stall. Downward movement of these pushing rods 27 is prevented by them touching the floor F of the seam.

The front ends of the pushing rods 27 are connected rigidly to the cutting head in a manner similar to that employed for the interconnection of the individual sections of the pushing rods.

Also mounted on the framework of the propulsion unit are a coal transfer chute 39 (Fig. 3) by which the conveyor belt 34 is caused to take a right-angle turn, an air hose (or electric cable) reel 40 and a water hose reel 41 (Fig. 4). The hoses and cables are supported on hooks 42 attached to the locking keys 31.

The propulsion unit is positioned in a vertical direction by four hydraulic jacks 43 (Figs. 2, 3, 4) and the thrust reaction from the hydraulic pushing cylinder 20 is taken by four hydraulic jacks 44 (Figs. 2, 3) acting between the girder framework 17 and both sides of the roadway. A guide frame 45 is provided at the face side of the propulsion unit.

The conveyor belt 34 in the roadway discharges at a normal tub or mine car loading station (not shown).

WHAT WE CLAIM IS:—

1. A mining machine comprising a propulsion unit or carriage which travels along a mine gate or roadway and is connected to a cutting head adapted to cut into a seam of mineral and is provided with means for forcing the cutting head into the seam and withdrawing the cutting head from the seam, characterised in that the cutting head is of the closed-loop type, and is connected to the propulsion unit or carriage by two or more horizontal or substantially horizontal pushing rods which are parallel to each other and can be extended laterally from the propulsion unit or carriage substantially perpendicularly to the direction of motion of the propulsion unit or carriage and move the cutting head in the direction in which they extend.

2. A machine according to Claim 1, characterised in that the parallel pushing rods comprise sections which are secured together by locking devices to which are attached bracing members such as cross-tubes whereby the pushing rods are interconnected.

3. A machine according to Claim 2, characterised in that the locking devices have keys which pass through the pushing rods and connectors for the pushing rods.

4. A machine according to Claim 2 or 3, characterised in that the locking devices are fitted with roller roof guides for preventing up-and-down movement or "whip" of the pushing rods.

5. A machine according to Claim 2, 3, or 4, characterised in that it comprises a belt conveyor for removing cut mineral away from the cutting head and rollers for supporting the conveyor belt are mounted on the bracing members interconnecting the pushing rods.

6. A machine according to any of the preceding claims, characterised in that the cutting head when fully retracted lies over the top of the propulsion unit.

7. A machine according to Claim 5, wherein the belt conveyor is pulled forward into the stall by the cutting head as the latter is pushed forward by the propulsion unit.

8. A machine according to any of the preceding claims, comprising a hydraulically-actuated sliding plate carrying advancing and retracting pawls which automatically engage extension pieces secured to the pushing rods for moving the cutting head into and out of the seam of mineral.

9. A machine according to Claim 8, wherein the pawls are provided with means,

for example balance weights, which cause the pawls to revert automatically to their operative positions after being deflected to pass under the extension pieces on the return stroke of the sliding plate.

10. A machine according to any of the preceding claims, wherein the cutting head is of the motor-driven closed-loop type fitted with centrally-located core-breakers.

11. A mining machine constructed and arranged substantially as hereinbefore described with reference to and as shown in the accompanying drawings.

For the Applicants.
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PROVISIONAL SPECIFICATION.

## Improvements in or relating to Mining Machines.

We, COAL INDUSTRY (PATENTS) LIMITED, a Company organised in accordance with the laws of Great Britain, of Hobart House, Grosvenor Place, London, S.W.1, do hereby declare this invention to be described in the following statement:—

The invention relates to mining machines for the mechanical winning and loading of mineral in mines, especially of coal and associated strata in coal mines.

In the conventional mining of coal by the stall system, after the initial drivage in coal and associated strata of two series of parallel roadways, generally at right angles the one to the other, the coal between such roadways is extracted by the working of narrow headings or stalls, some two to ten yards in width, either by hand or by short-wall cutting machines or similar devices. After breaking down the coal, usually by means of explosives, the broken coal is loaded by hand or mechanical device either directly into tubs or through the medium of a conveyor. The roof in the stall is usually supported on props and bars either of wood or steel.

An object of the present invention is to provide an improved machine whereby it is possible to win and load the coal simultaneously, without the necessity of men having to enter the stall from which the coal is being extracted and also with the complete absence of roof supports in the stall.

According to the invention there is provided a mining machine comprising a propulsion unit or carriage adapted to travel along a mine gate or roadway, a closed loop cutting head adapted to cut into a seam of mineral, interconnected parallel pushing rods in sections of suitable length which can be joined together, and means on the propulsion unit for acting through the pushing rods to force the cutting head into the seam or to withdraw it therefrom. The cutting head preferably comprises a source of power such as an electric motor or pneumatic or hydraulic turbine or vane motor for driving the cutting elements. There may be two parallel pushing rods, and these may be hollow and of any suitable cross-section, for example of box-section. The sections of the pushing rods may be secured together by locking devices to which are attached bracing members whereby the pushing rods are interconnected. Any suitable means may be provided for progressing cut mineral away from the cutting head: in one advantageous construction such means is in the form of a belt conveyor, and rollers for supporting the belt may be mounted on the bracing members interconnecting the pushing rods. The means on the propulsion unit for forcing the cutting head into the seam and/or withdrawing may comprise a hydraulic cylinder. The propulsion unit is situated in the preformed gate or roadway and the operators, two in number, can control the complete working of the machine from this gate or roadway.

When the cutting unit is fully retracted from the seam position into the preformed gate or roadway, the cutting unit lies over the top of the hydraulic propulsion unit. This arrangement is compact and allows direct entry of the cutting head into the coal at the commencement of each stall. In an advantageous construction the cutting head comprises two pilot drills and cutter picks attached to two mushroom-shaped housings to cut clearances for two sprockets driving a main cutting chain. The latter may cut annulus equal to the height of the seam and of a predetermined length of six feet or more. Power for the cutting elements from a compressed air turbine or electric motor may be transmitted through reduction gearing and flexible coupling. A compressed air hose or electric cable may be stowed on a reel or reels mounted on the hydraulic unit and be paid out as the cutter head advances in the seam. A water hose may be similarly carried to supply sprays for dust suppression at the face of the stall. So that any fillet of mineral left within the annulus of the cutting head may be broken down the chain guide may be fitted with breaker knives. The broken coal or mineral and cuttings from the various cutting members may be constrained by guide plates to move on to progressing means such as a conveyor belt.

Preferably there is a belt conveyor arranged to be pulled forward in the stall by the cutting head as the latter is pushed forward by the propulsion unit; at the junction of the stall and the roadway the conveyor belt may take a right-angled or other turn into the roadway and pass to an appropriate loading jib by which the mineral or coal is delivered into tubs or mine cars. Sufficient spare belting for the conveyor may be stored in a loop take-up to allow of the forward movement of the head of the conveyor along the stall, with the cutting head. A right-angled or other turn in the belt can be achieved by appropriately designed and placed rollers. Means may be provided for preventing up-and-down movement or "whip" of the pushing rods. Further features of the invention appear from the following description and the accompanying drawings.

In the accompanying drawings the invention is illustrated by way of example.

Figure 1 being a simplified diagram of the general arrangement of a machine according to the invention as seen in side view;

Figure 2 a side elevation of a machine according to the invention;

Figure 3 a plan corresponding to Figure 2;

Figure 4 a section on the line A—A of Figure 2;

Figure 5 a sectional detail view of a pushing rod joint;

Figure 6 a view in the direction of arrow B of Figure 5;

Figure 7 a side view of a roof guide;

Figure 8 an end view of the roof guide of Figure 7; and

Figure 9 a diagrammatic view of the cutting line of the cutting head.

The illustrated machine comprises a cutting head which carries two pilot drills 1; two sprocket clearance cutters 2 having mushroom-shaped housings fitted with cutter picks; a cutter chain 3 fitted with cutter boxes 4 and cutter picks 5 driven by the driving sprocket 6 with a return tension sprocket 7. These cutting elements cut the coal in a forward direction, the chain cutting an elongated annulus whilst the pilot drills 1 and sprocket clearance cutters 2 remove the coal to allow the forward movement of the driving and tension sprockets 6 and 7.

Drive for the cutting elements 1, 2, 3, is derived from a compressed-air turbine (or electric motor) 8 through reduction gearing 9 and flexible coupling 10.

The cutting elements 1, 2, 3 leave a solid fillet of coal within the annulus and this coal is broken down by contact with a series of breaker knives 11. The cuttings and broken coal are diverted on to a belt conveyor 12 by means of a chute 13. The cutting elements 1, 2, 3, driving unit 8 and gearing 9, a return roller 14 for the conveyor belt 12 and four spring-loaded guide blocks 15 are mounted on a base plate 16.

The propulsion unit, which is situated in the roadway from which the stalls are to be driven in the coal seam, comprises a steel girder construction framework 17 mounted on wheels 18 which in turn run on steel rails 19 for ease of movement to successive stall positions along the roadway. Within this framework 17 is mounted a horizontal hydraulic pushing cylinder 20 attached to two cross-members 21 provided with cylindrical slides 22 moving on heavy tubular guides 23. Motive power for the horizontal pushing cylinder 20 is supplied by an all-enclosed motor-driven hydraulic unit 24 mounted on the girder framework.

Attached to the cross-members 21 of the pushing cylinder 20 are two specially designed pushing pawls 25 for forward movement and two similar pawls 26 for backward movement of an assembly of square-section pushing rods 27. When the cutting head is being advanced along the stall, the backward movement pawls 26 are locked out of position. The forward movement pawls 25 automatically engage the concave extension pieces 28 secured to the pushing rods 27. After the pushing cylinder 20 has moved its full stroke it is retracted, and on the reverse movement the forward movement pawls 25 are deflected into a horizontal position by the passage of succeeding pieces 28 at the joints in the pushing rods 27, but the pawls 25 revert to their vertical position by the action of balance weights 29. The pawls 25 can then automatically engage with the concave extension pieces 28 as the forward and reverse strokes of the pushing cylinder 20 are repeated.

When withdrawing the cutting head from the stall the forward moving pawls 25 are locked out of position, and the backward moving pawls 26 are freed for operation and the pawls 26 have an operation which is of a similar nature to that of the pawls 25 but in the reverse direction.

The pushing rods 27 are of box-section construction and are made in suitable lengths for ease of attachment and detachment. Each section is connected rigidly to its neighbour by a locking device. For each joint a short length of solid square section steel forming a connector 30 has one end welded inside one end of one pushing rod section; the other end slides into the open end of the next pushing rod section. This square connector 30 is positioned and locked by a key 31 on an interlock plate 32 which is dropped into the deep slot formed by a rectangular recess 33 cut in the connector 30 and a similarly-dimensioned recess 34 cut in the pushing rod section. The joint is further locked by engaging the two pins 35 of the vertical spring-loaded roof guides 36

in the holes drilled through the outer part of one rod 27 and the inner connector 30 secured in the adjoining rod 27.

The joint interlock plates 32 form parts of spacer units which also comprise two cross-tubes 37 each and brace together the parallel pushing rods 27. Each spacer unit also carries trough idlers 38 for supporting the conveyor belt 12. The vertical spring-loaded roof guides 36 are provided to prevent "whip" on the pushing rods 27 as the cutting head is pushed forward into the stall. Downward movement of these pushing rods 27 is prevented by them touching the floor F of the seam.

The front ends of the pushing rods 27 are connected rigidly to the cutting head in a manner similar to that employed for the interconnection of the individual sections of the pushing rods.

Also mounted on the framework of the propulsion unit are a coal transfer chute 39 by which the conveyor belt 12 is caused to take a right-angled turn, an air hose (or electric cable) reel 40 and a water hose reel 41. The hoses and cables are supported on hooks 42 attached to the spacer bar units.

The propulsion unit is positioned in a vertical direction by four hydraulic jacks 43, and the thrust reaction from the hydraulic pushing cylinder 20 is taken by two hydraulic jacks 44 acting between the girder framework 17 and the side of the roadway.

The conveyor belt 12 in the roadway terminates in a normal tub or mine car loading station (not shown).

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Chartered Patent Agent.

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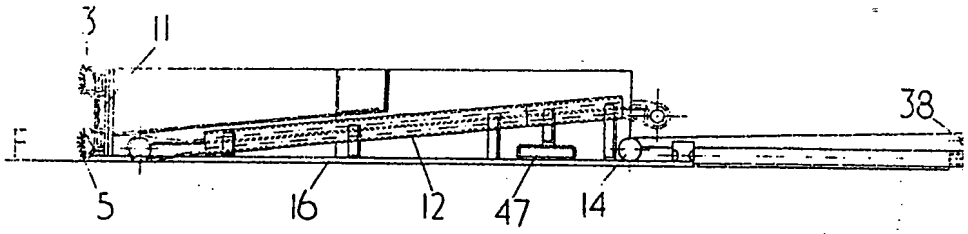


FIG. 1.

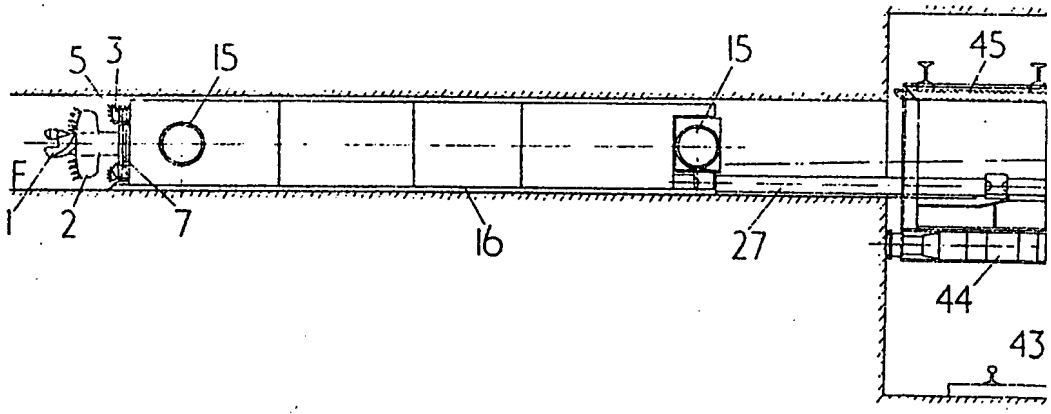


FIG. 2.

800,864 COMPLETE SPECIFICATION

3 SHEETS

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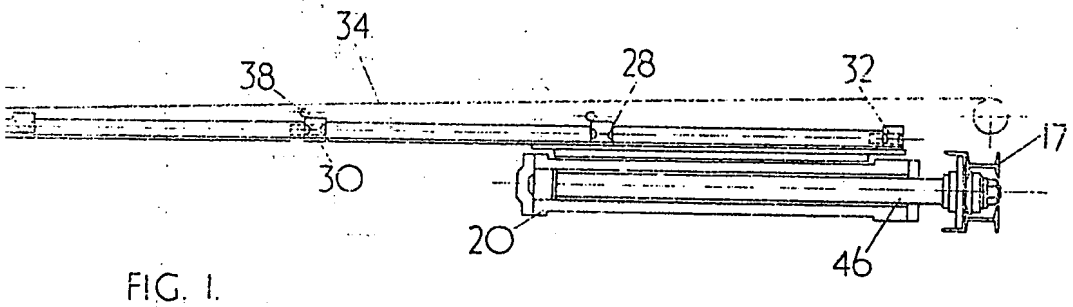
*SHEET 1*

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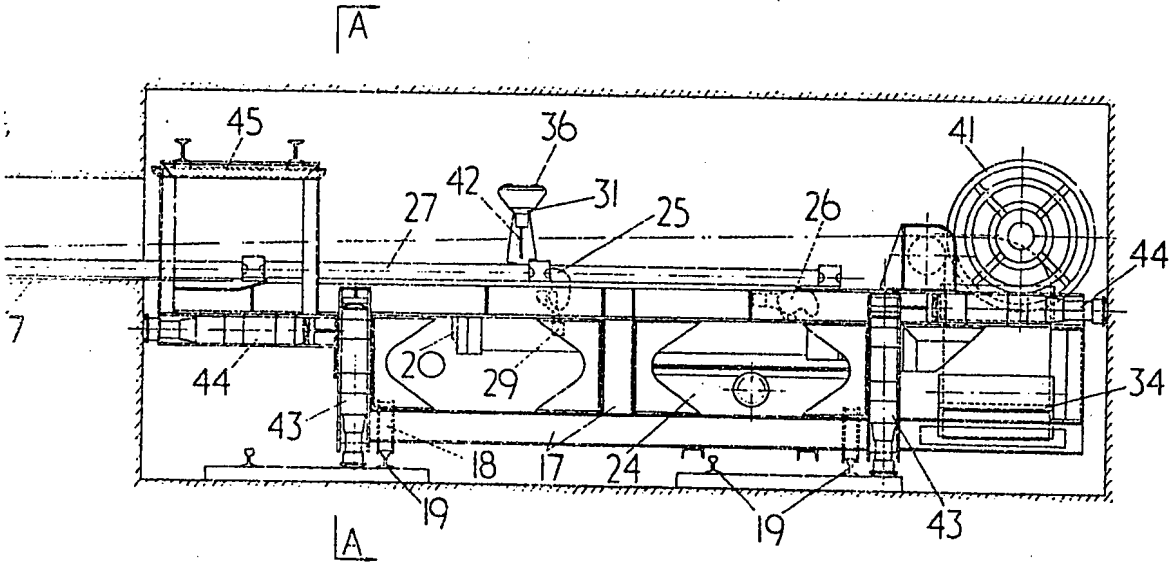


FIG. 2.

800,864 COMPLETE SPECIFICATION

3 SHEETS This drawing is a reproduction of the Original on a reduced scale. SHEET 1

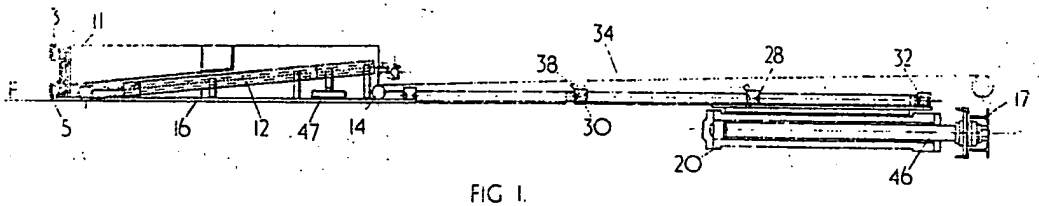


FIG. 1.

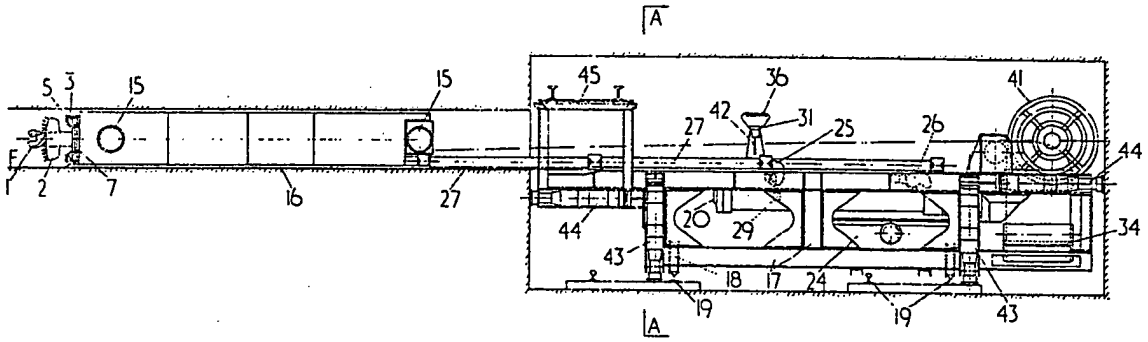


FIG. 2.

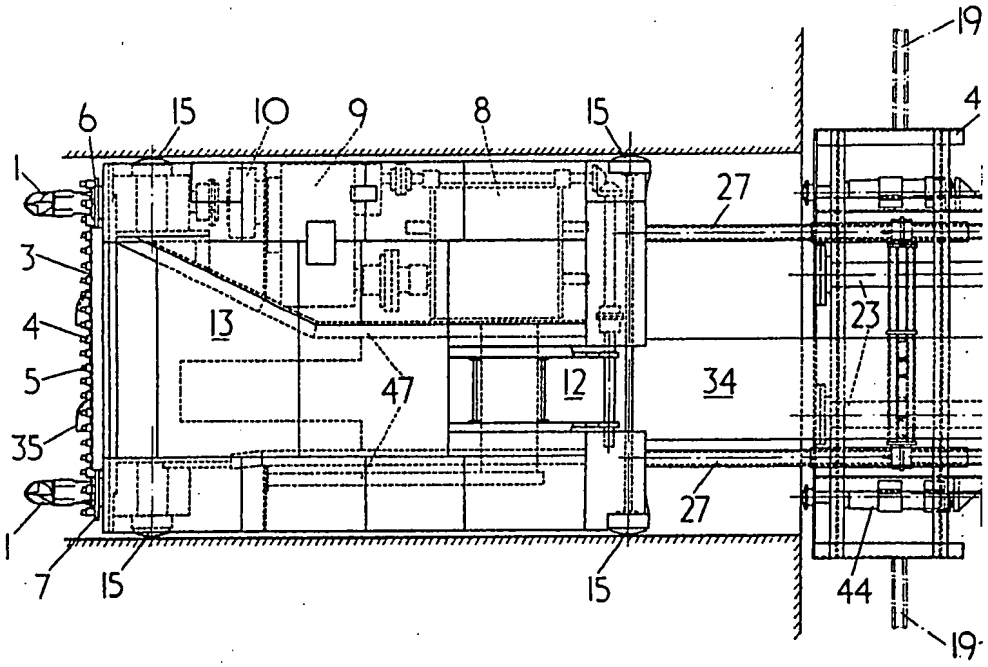
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FIG. 3.

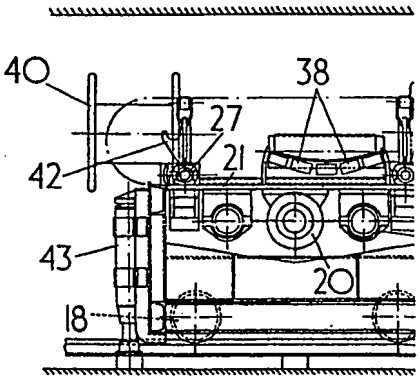
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FIG. 4.

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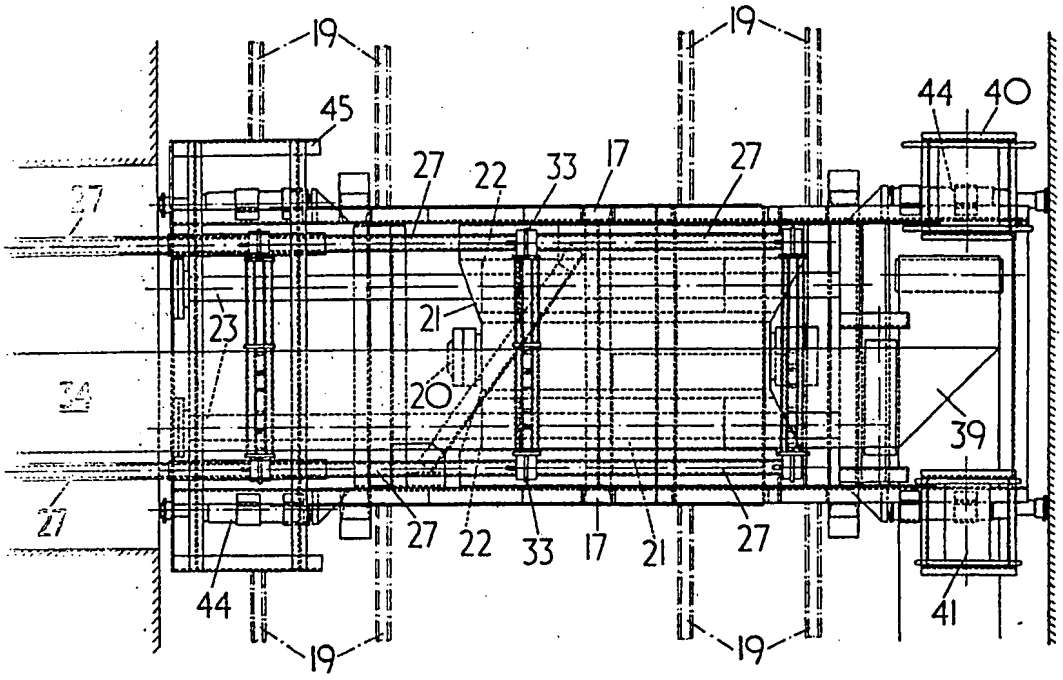


FIG. 3.

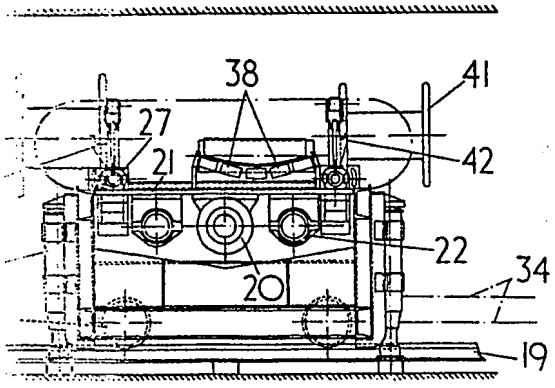


FIG. 4.

800,864 COMPLETE SPECIFICATION
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SHEET 2

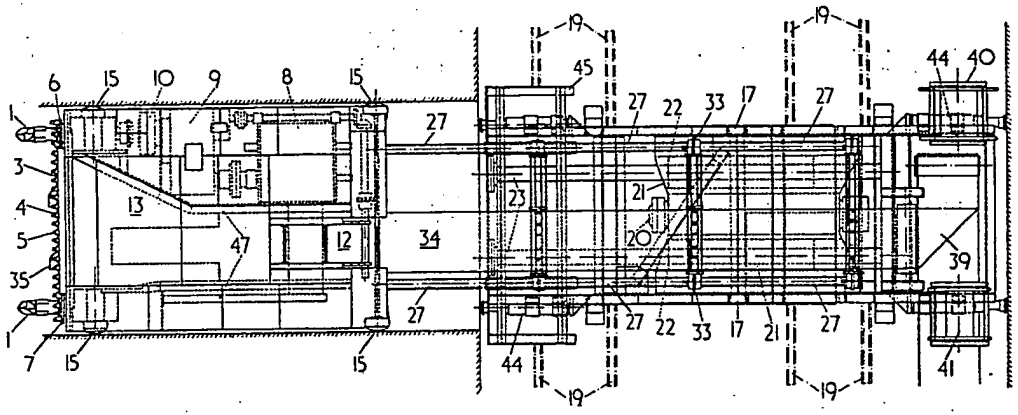


FIG. 3.

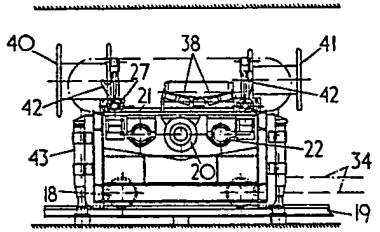


FIG. 4.

800,864 COMPLETE SPECIFICATION
3 SHEETS
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*SHEET 3*

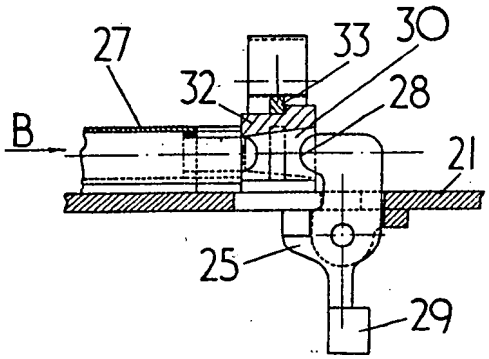



FIG. 5.

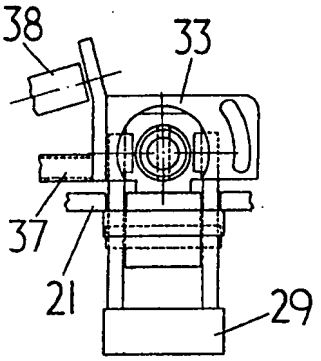



FIG. 6.

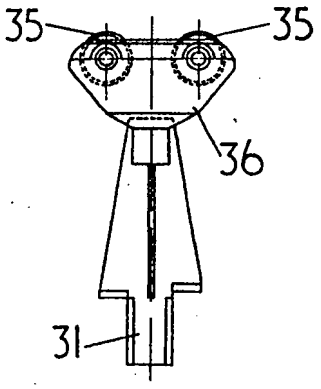



FIG. 7.

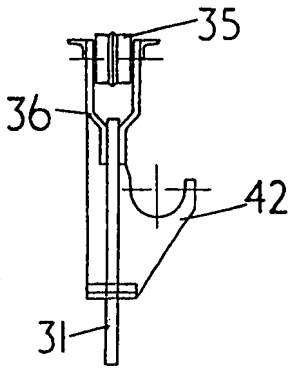



FIG. 8.

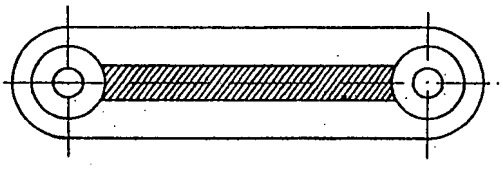


FIG. 9.

FIG. 1.

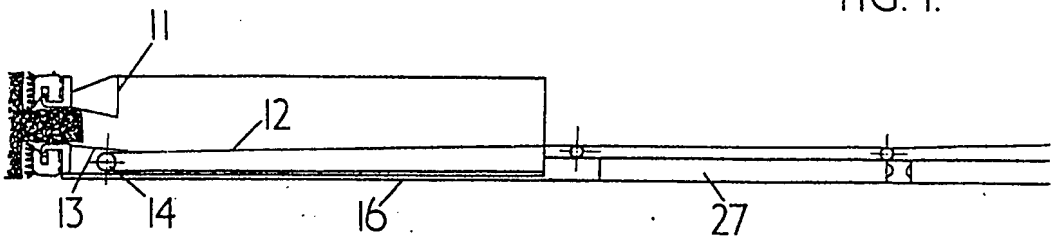
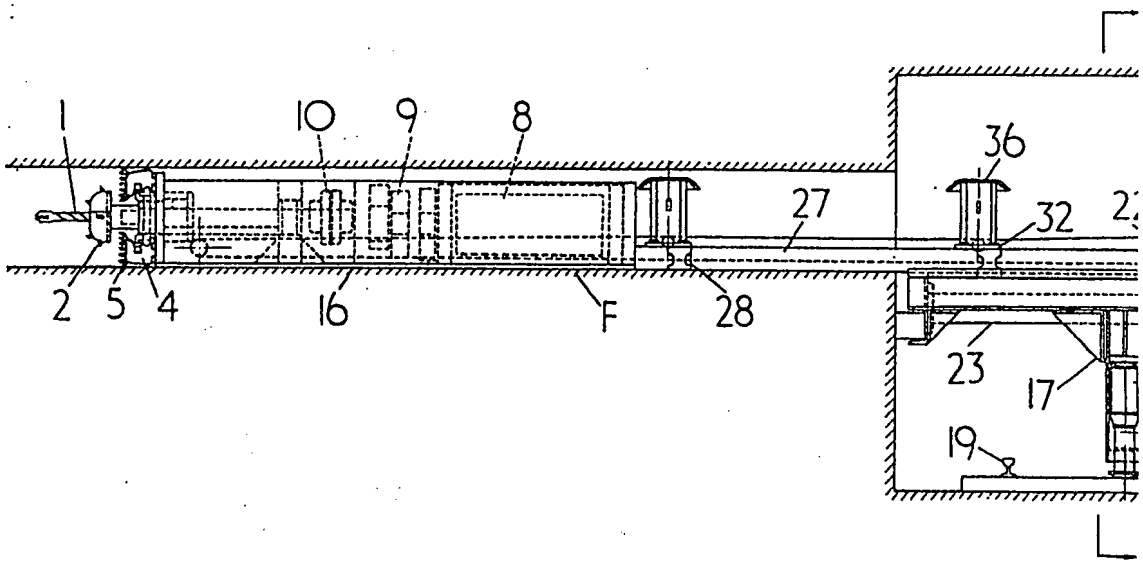



FIG. 2.



800,864 PROVISIONAL SPECIFICATION
3 SHEETS

This drawing is a reproduction of the Original on a reduced scale.
SHEET 1

FIG. 1.

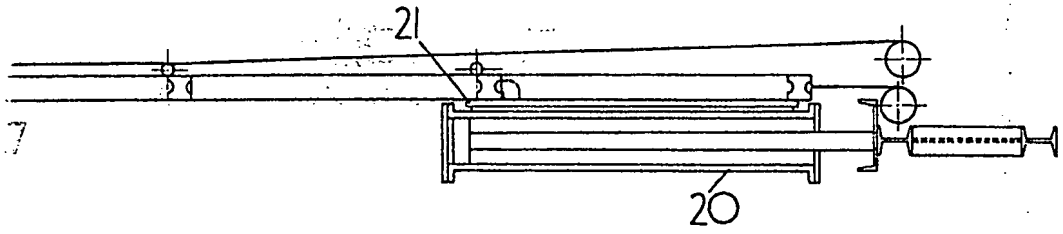
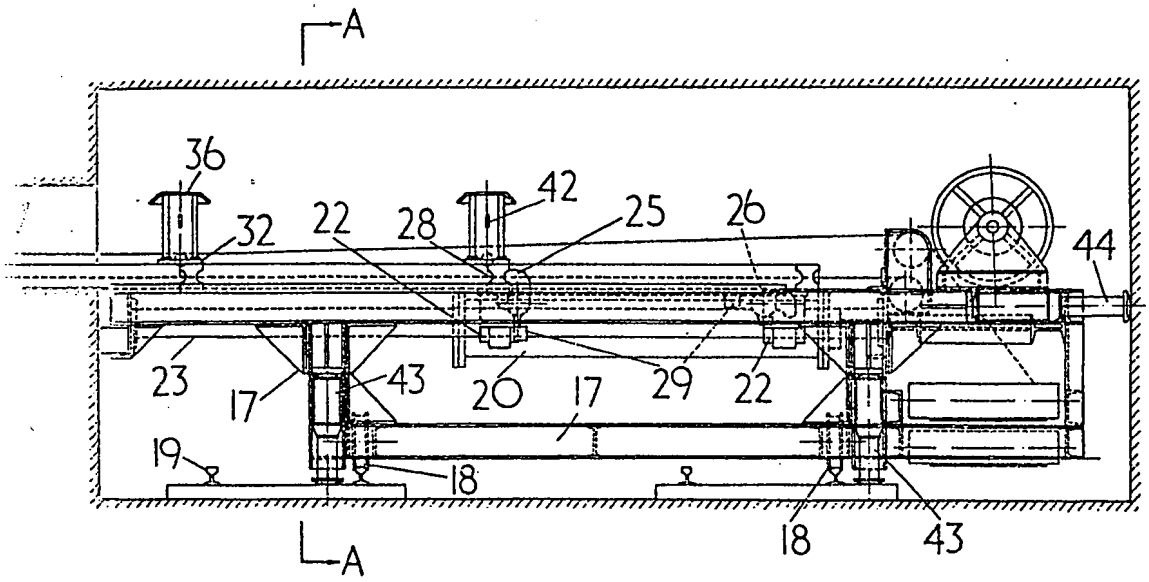



FIG. 2.



800,864 PROVISIONAL SPECIFICATION
3 SHEETS This drawing is a reproduction of the Original on a reduced scale.
SHEET 1

FIG. 1.

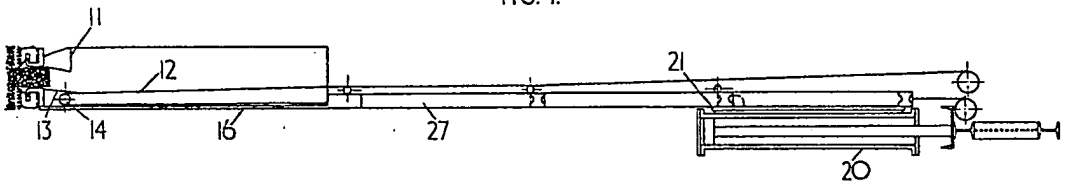



FIG. 2.

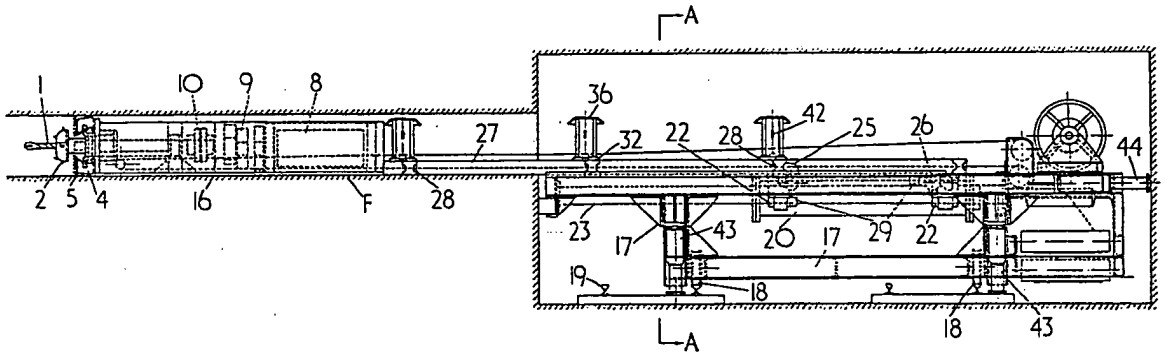


FIG. 3.

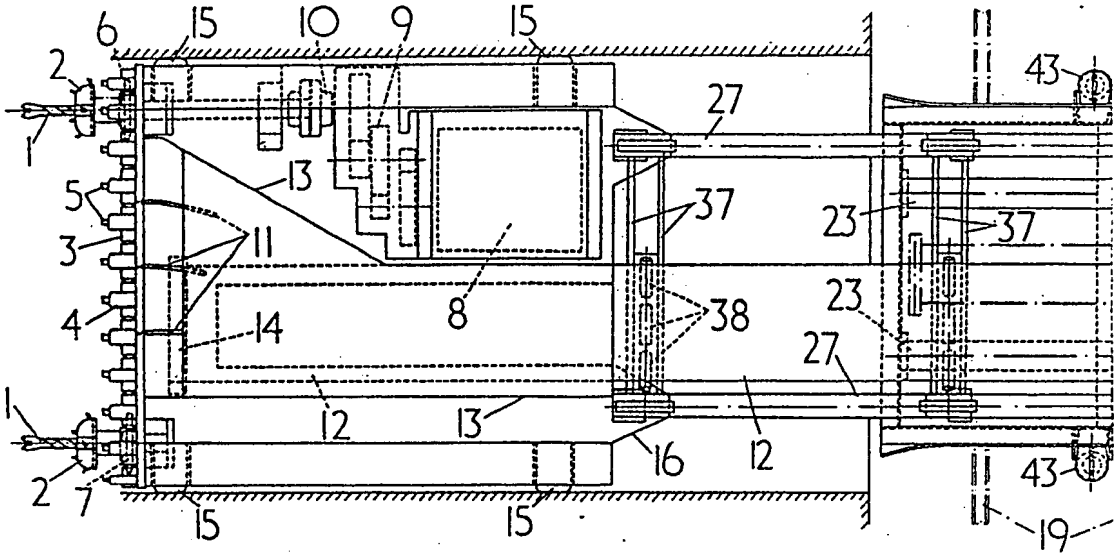

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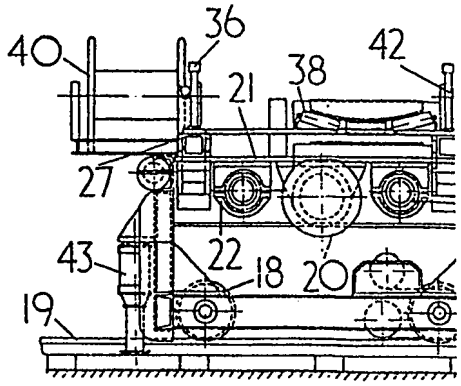
FIG. 4.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800,864 PROVISIONAL SPECIFICATION
3 SHEETS

*This drawing is a reproduction of the Original on a reduced scale.*
*SHEET 2*

FIG. 3.

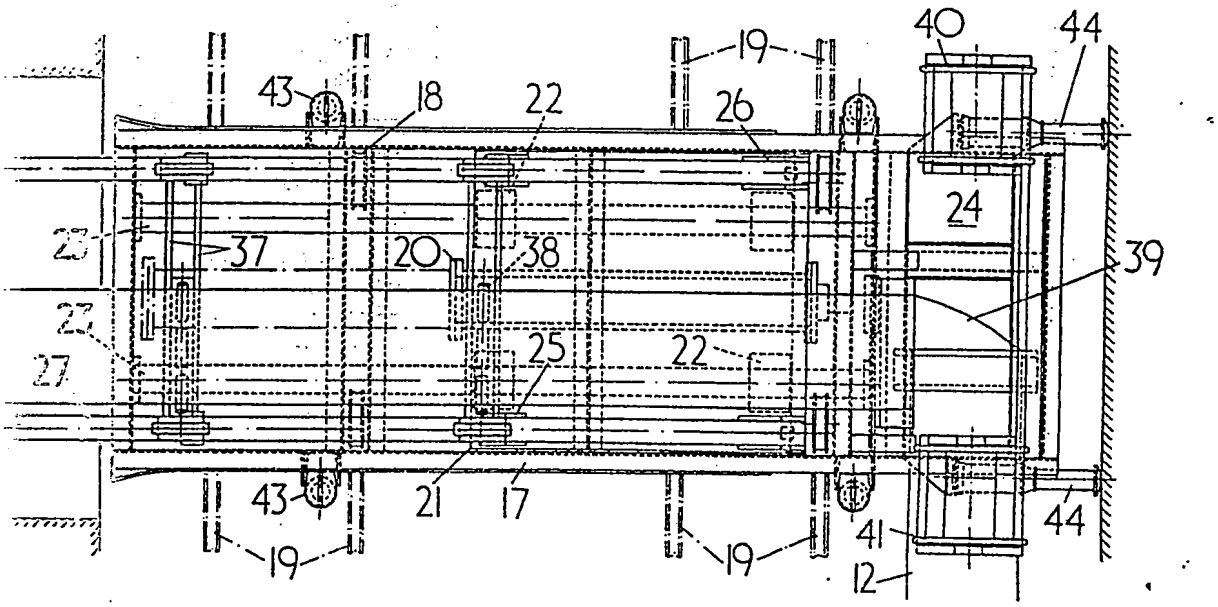
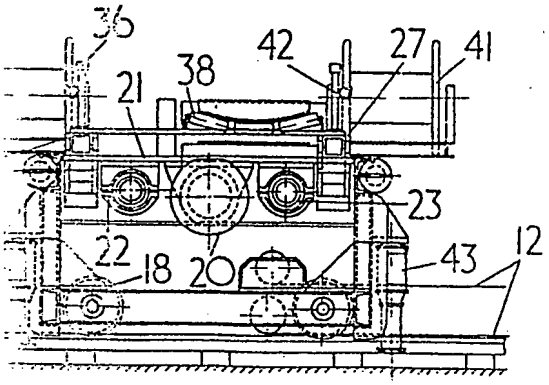



FIG. 4.



800,864 PROVISIONAL SPECIFICATION
3 SHEETS This drawing is a reproduction of the Original on a reduced scale.
SHEET 2

FIG. 3.

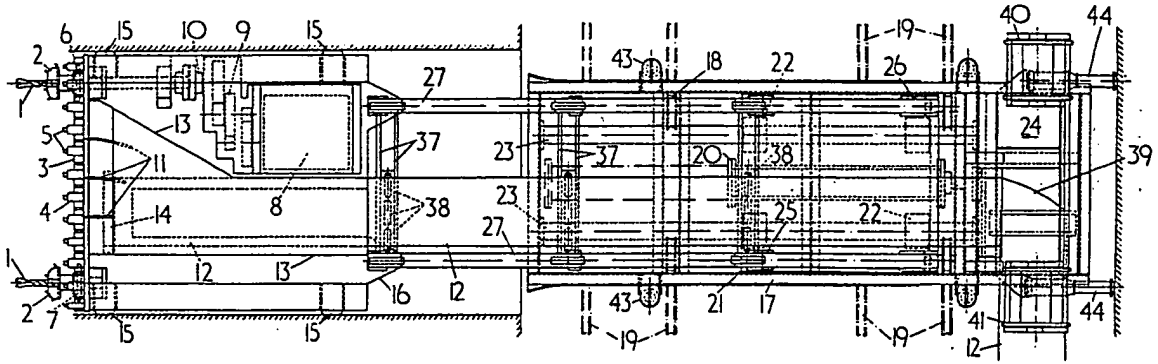
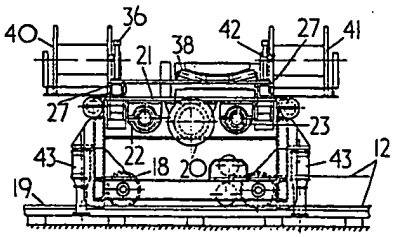
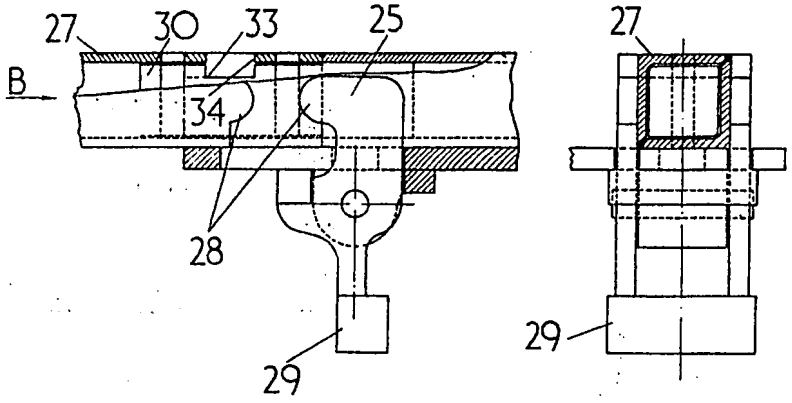



FIG. 4.



800,864 PROVISIONAL SPECIFICATION
3 SHEETS

*This drawing is a reproduction of the Original on a reduced scale.*
*SHEET 3*



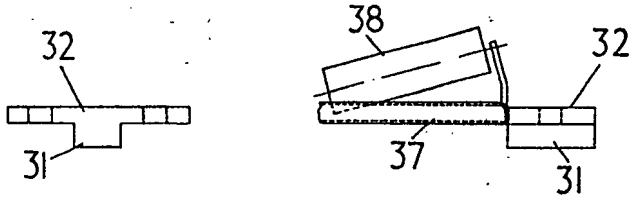
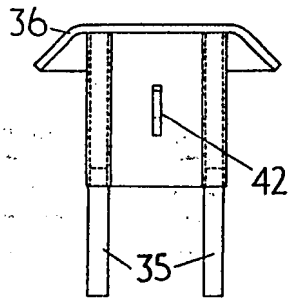




FIG. 5.

FIG. 6.



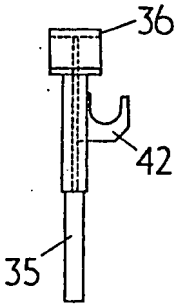




FIG. 7.

FIG. 8.

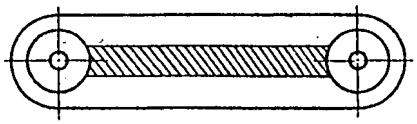


FIG. 9.